

CLAIMS

1. A similar-pattern searching apparatus for searching a pattern having a high similarity to a pattern of a test sample from a group including a plurality of patterns, the
5 similar-pattern searching apparatus comprising:
a storage unit that stores a class map generated by selecting model parameters that characterize a plurality of component fractions included in each of the patterns, and by clustering the patterns; and
10 a similar-pattern searching unit that selects a class similar to a component fraction included in the pattern of the test sample from the class map.
2. The similar-pattern searching apparatus according to
15 claim 1, wherein the patterns are one-dimensional or multi-dimensional patterns.
3. The similar-pattern searching apparatus according to claim 2, wherein the patterns are leukocyte particle size
20 patterns, protein electrophoretic waveforms, or blood cell histograms.
4. A similar-pattern searching method of searching a pattern having a high similarity to a pattern of a test
25 sample from a group including a plurality of patterns, the similar-pattern searching method comprising:
a class-map generating step of selecting model parameters that characterize a plurality of component fractions included in each of the patterns, clustering the
30 patterns, and generating a class map;
a storage step of storing the class map generated at the class-map generating step; and
a similar-pattern searching step of selecting a class

similar to a component fraction included in the pattern of the test sample from the class map.

5. A similar-pattern search program that realizes on a computer a similar-pattern searching method of searching a pattern having a high similarity to a pattern of a test sample from a group including a plurality of patterns, the similar-pattern search program causing the computer to execute:

10 a class-map generating process of selecting model parameters that characterize a plurality of component fractions included in each of the patterns, clustering the patterns, and generating a class map;

a storage process of storing the class map generated at the class-map generating process; and

a similar pattern search step of selecting a class similar to a component fraction included in the pattern of the test sample from the class map.

20 6. A similar-pattern searching apparatus for searching a leukocyte particle size pattern having a high similarity to a leukocyte particle size pattern of a test sample from a group including a plurality of leukocyte particle size patterns, each of the leukocyte particle size patterns including a plurality of cellular component fractions, the similar-pattern searching apparatus comprising:

a primary clustering unit that clusters the leukocyte particle size patterns obtained by a measurement while applying a self-organizing map to the leukocyte particle size patterns, and that generates a primary class map;

30 a first-parameter determining unit that executes an EM algorithm for the respective leukocyte particle size patterns included in the primary class map using

predetermined initial values, thereby determining first-mixture-distribution model parameters including the number of cellular components contained in each of the patterns, and an average, a variance, and a density of each of the cellular components;

a second-parameter determining unit that executes the EM algorithm for the respective leukocyte particle size patterns using the first-mixture-distribution model parameters as the initial values, thereby determining second mixture distribution model parameters including the number of the cellular components contained in each of the leukocyte particle size patterns, and the average, the variance, and the density of each cellular component;

a secondary clustering unit that clusters the respective leukocyte particle size patterns while applying the self-organizing map to the first mixture distribution model parameters, and that generates a secondary class map;

an inter-class distance master generator that calculates similarity distances between all combinations of respective classes included in the secondary class map, and that generates an inter-class distance master in which the combinations of the classes correspond to the respective inter-class similarity distances;

a storage unit that stores the secondary class map and the inter-class distance master;

a class determining unit that determines a class belonging to each of cellular component fractions included in the leukocyte particle size pattern of the test sample from the secondary class map; and

a similar-pattern searching unit that detects, as a similar class, a class which similarity distance from the class determined by the class determining unit is equal to or smaller than a predetermined threshold, from the inter-

class distance master, and that determines a leukocyte particle size pattern included in the similar class as the pattern having the high similarity to the leukocyte particle size pattern of the test sample.

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7. A similar-pattern searching method of searching a leukocyte particle size pattern having a high similarity to a leukocyte particle size pattern of a test sample from a group including a plurality of leukocyte particle size patterns, each of the leukocyte particle size patterns including a plurality of cellular component fractions, the similar-pattern searching method comprising:

10 a primary clustering step of clustering the leukocyte particle size patterns obtained by a measurement while applying a self-organizing map to the leukocyte particle size patterns, and generating a primary class map;

15 a first-parameter determining step of executing an EM algorithm for the respective leukocyte particle size patterns included in the primary class map using predetermined initial values, thereby determining first-mixture-distribution model parameters including the number of cellular components contained in each of the patterns, and an average, a variance, and a density of each of the cellular components;

20 a second-parameter determining step of executing the EM algorithm for the respective leukocyte particle size patterns using the first-mixture-distribution model parameters as the initial values, thereby determining second mixture distribution model parameters including the number of the cellular components contained in each of the leukocyte particle size patterns, and the average, the variance, and the density of each cellular component;

25 a secondary clustering step of clustering the

respective leukocyte particle size patterns while applying the self-organizing map to the first mixture distribution model parameters, and generating a secondary class map;

an inter-class distance master generating step of
5 calculating similarity distances between all combinations of respective classes included in the secondary class map, and generating an inter-class distance master in which the combinations of the classes correspond to the respective inter-class similarity distances;

10 a storing step of storing the secondary class map and the inter-class distance master;

a class determining step of determining a class belonging to each of cellular component fractions included in the leukocyte particle size pattern of the test sample
15 from the secondary class map; and

a similar-pattern searching step of detecting, as a similar class, a class which similarity distance from the class determined at the class determining step is equal to or smaller than a predetermined threshold, from the inter-
20 class distance master, and determining a leukocyte particle size pattern included in the similar class as the pattern having the high similarity to the leukocyte particle size pattern of the test sample.

25 8. A similar-pattern search program that realizes on a computer a similar-pattern searching method of searching a leukocyte particle size pattern having a high similarity to a leukocyte particle size pattern of a test sample from a group including a plurality of leukocyte particle size
30 patterns, each of the leukocyte particle size patterns including a plurality of cellular component fractions, the similar-pattern search program causing the computer to execute:

a primary clustering process of clustering the leukocyte particle size patterns obtained by a measurement while applying a self-organizing map to the leukocyte particle size patterns, and generating a primary class map;

5 a first-parameter determining process of executing an EM algorithm for the respective leukocyte particle size patterns included in the primary class map using predetermined initial values, thereby determining first-mixture-distribution model parameters including the number
10 of cellular components contained in each of the patterns, and an average, a variance, and a density of each of the cellular components;

 a second-parameter determining process of executing the EM algorithm for the respective leukocyte particle size
15 patterns using the first-mixture-distribution model parameters as the initial values, thereby determining second mixture distribution model parameters including the number of the cellular components contained in each of the leukocyte particle size patterns, and the average, the
20 variance, and the density of each cellular component;

 a secondary clustering process of clustering the respective leukocyte particle size patterns while applying the self-organizing map to the first mixture distribution model parameters, and generating a secondary class map;

25 an inter-class distance master generating process of calculating similarity distances between all combinations of respective classes included in the secondary class map, and generating an inter-class distance master in which the combinations of the classes correspond to the respective
30 inter-class similarity distances;

 a storing process of storing the secondary class map and the inter-class distance master;

 a class determining process of determining a class

belonging to each of cellular component fractions included in the leukocyte particle size pattern of the test sample from the secondary class map; and

5 a similar-pattern searching process of detecting, as a similar class, a class which similarity distance from the class determined at the class determining process is equal to or smaller than a predetermined threshold, from the inter-class distance master, and determining a leukocyte particle size pattern included in the similar class as the
10 pattern having the high similarity to the leukocyte particle size pattern of the test sample.

9. A cellular-component-fraction separating apparatus for separating a plurality of cellular component fractions
15 included in a leukocyte particle size pattern, the cellular-component-fraction separating apparatus comprising:

a primary clustering unit that clusters a plurality of leukocyte particle size patterns, which are obtained by
20 measurement, while applying a self-organizing map to the leukocyte particle size patterns, and that generates a primary class map;

a parameter determining unit that executes an EM algorithm for the respective leukocyte particle size
25 patterns included in the primary class map using predetermined initial values, thereby determining mixture distribution model parameters including the number of cellular components contained in each of the patterns, and an average, a variance, and a density of each of the
30 cellular component fractions; and

a fraction separating unit that executes the EM algorithm for the respective leukocyte particle size patterns using the mixture distribution model parameters as

the initial values, thereby separating the cellular component fractions included in each of the leukocyte particle size patterns.